Allt Leacach, Loch Aline, Highland

[NM 692 454]

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Introduction

The Sound of Mull is famed for its attractive Tertiary volcanic and Moinian basement scenery. Along the NE shores of the Sound of Mull, however, between Rubha na Ridire and the narrow entrance to Loch Aline, a noticeably different style of cliff architecture is evident. This identifies the outcrop of a Carboniferous to Cretaceous sequence, variably preserved beneath a horizontal cap of Palaeocene basalt belonging to the Mull Tertiary igneous centre (Figure 8.19).

Included within this sequence is a more-or-less complete Hettangian to mid-Sinemurian Lias Group succession. These Jurassic rocks are most accessible in a series of stream sections which expose the bedrock beneath an extensive scree that otherwise obscures the lower cliff section. These cliffs no longer experience active marine erosion, being protected by the '6 foot' emerged ('raised') beach, a relatively recent effect of post-glacial isostatic re-adjustment. The most complete sections are accessible in stream beds around the shores of Loch Aline itself particularly on its south-east side. Of these Allt Leacach provides the best exposure, although not all beds can be examined at close quarters without either a top rope or taking unnecessary risks in scaling the lowest waterfall during a period of low runoff. Unlike many south Hebridean Jurassic outcrops, this area is largely unaffected by Tertiary igneous-related thermal metamorphism, excepting only the immediate vicinity of intrusive sills and dykes.

The horizontal beds of the lower Lias Group here span an interval from within the Angulata Zone, at the base, up to the Obtusum Zone immediately beneath the unconformity with overlying Cretaceous sediments. The lithostratigraphical divisions are a lower Blue Lias Formation overlain by the Pabay Shale Formation. The Blue Lias Formation, as elsewhere, comprises an alternating, decimetre-scale, series of argillaceous limestone with silty shale. The Pabay Shale Formation consists predominantly of coarser, heavily bioturbated clastics. Diligent searching has yielded many ammonites that have proven crucial to establishing the biostratigraphy of the succession.

Although Allt Leacach has been designated the principal GCR site for this area, it should not be considered in isolation. Beds higher than those exposed in Allt Leacach are accessible in Allt Mor, 2 km to the south [NM 700 435] and the slight unconformity between the Blue Lias and Pabay Shale formations can be demonstrated only by comparing the relevant sections in adjacent streams. Similarly, bed variation within the Blue Lias Formation becomes apparent only from examination of all of the principal sections around Loch Aline. This variation involves a breakdown of the regular periodicity in the bedding, and an increase in limonite and coarse bioclastic material towards the north-east, possibly indicating the proximity of a contemporary coastline. As the most complete section in the area of outcrop, it forms a useful reference section, against which the other stream and trackside exposures in the Loch Aline area may be compared. The site was first noted by Judd (1878), with further details of the section recorded by MacLennan (1954). Other references to the site are found in Arkell (1933), Lee and Bailey (1925) and Richey and Thomas (1930), with a summary graphic log included in Copestake and Johnson (1989). More detailed accounts have been published by Oates (1976, 1978) and Hesselbo *et al.* (1998).

Description

The principal section is that exposed in the degraded cliff line at Allt Leacach (Figure 8.20), the name being a Gaelic allusion to stone slabs. A total of 62 m is exposed in three major waterfalls and the stream beds joining them. The section is more-or-less horizontally bedded and unfaulted. The strata exposed are grouped into two formations, the Blue Lias Formation and the Pabay Shale Formation (Figure 8.21). Nowhere is the base of the Blue Lias Formation seen around Loch Aline. At Allt Leacach *Schlotheimia similis* appears in Bed 5, 2 m above the lowest beds observed in the stream, and is abundant through the next 7 m of strata up to Bed 17. Only a small indeterminate schlotheimiid is recorded below

this level, in the lower part of Bed 4. A specimen of *Schreinbachtites* sp. (recorded as *Vermiceras* in Hesselbo *et al.,* 1998) was found at the top of Bed 10. The ratio of shaley mudstone to limestone in this part of the succession increases upwards to a thick mudstone unit well exposed at the base of the lowest waterfall, but both the limestones and mudstones in this lower part of the formation are poorly fossiliferous.

No ammonites have been recovered from an interval of more than 11 m above the last *Schlotheimia.* The first appearance of *Gryphaea arcuata is* in Bed 28. Above this level both limestones and mudstones are significantly more fossiliferous than lower in the succession; crinoid debris is common in the limestones while *Gryphaea* is abundant throughout. Foreshore exposures on the opposite, western, shore of Loch Aline were the source of specimens of *Gryphaea* used in MacLennan and Trueman's (1942) study of morphological variation in this species. *Metophioceras conybeari* has been recorded from the base of Bed 37, with *Coroniceras* d *rotiforme* in beds 42 and 44, abundant *Coroniceras kridion* in Bed 47, and a single fragment of *Epammonites latisulcatus* from about the middle of Bed 47. *Arnioceras* sp. is present in beds 52 and 53, just below the first appearance of *Oxytoma inaequivalvis.* A thin, lenticular, limonitic bed is present in Bed 40 and is an important marker bed.

The junction of the Blue Lias and Pabay Shale formations is well exposed in the sloping stream bed above the lowest waterfall. The top of the Blue Lias Formation weathers red while *Gryphaea* shells are occasionally truncated at the contact between the two formations. The Pabay Shale Formation comprises a more-or-less continuous series of bioturbated silts and sands with occasional nodular beds and thin sandstones. *Caenisites turneri, Microderoceras birchi* and *Promicroceras* are abundant in laminated mudstones in the lowest 9 m (beds 58 to 67). The base of the sandy limestone of Bed 68 has a slightly erosional character and is succeeded by further laminated mudstones and thin sandstones that have yielded *Promicroceras, Xipheroceras* and *Asteroceras obtusum.* A single *Aegasteroceras* fragment was found in the middle of Bed 72. In Allt Leacach only 28 m of the Pabay Shale Formation is preserved beneath the unconformity at the base of the Cretaceous succession. The somewhat sandy nature of the upper part of the Pabay Shale Formation here led Arkell (1933) to refer to this part of the succession as the 'Loch Aline Sandstone'. This term has never otherwise been adopted; partly because it is somewhat of a misnomer and also because of possible confusion with the Cretaceous silica sand that is mined on the west side of Loch Aline.

Interpretation

The lowest 9 m of the Blue Lias Formation exposed here clearly lies entirely within the Angulata Zone, with *Schlotheimia similis* suggesting a level (*simile* Biohorizon) low in the Complanata Subzone. Higher levels in this zone remain unproven, although *Schreinbachtites is* typically a late-Angulata Zone genus (Depressa Subzone; see (Figure 1.3), Chapter 1). Hesselbo *et al.* (1998) placed the Hettangian–Sinemurian boundary at the level of the first appearance of *Gryphaea arcuata,* although this species is known to extend down into the Angulata Zone. At present the base of the Bucklandi Zone, and Sinemurian Stage, must be drawn at the first appearance of *Metophioceras conybeari,* in Bed 37, indicating the Conybeari Subzone. The base of the succeeding Rotiforme Subzone is placed at the base of Bed 42, marked by the first appearance of *Coroniceras* c.f. *rotiforme, with Coroniceras kridion* in Bed 47 indicating the *kridion* Biohorizon towards the top of the sub-zone. The boundary with overlying Bucklandi Subzone is tentatively placed a little higher in Bed 47, indicated by *Epammonites latisulcatus.* The occurrence of *Arnioceras* in beds 52 and 53 is definite evidence for a level above the Rotiforme Subzone, but is not conclusive proof of the Semicostatum Subzone.

There is convincing evidence, both here and in adjacent exposures, for a minor unconformity between the Blue Lias and Pabay Shale formations. The iron-stained top to the Blue Lias Formation and the presence of *Gryphaea* truncated by erosion is the most direct evidence, but it is also suggested by the absence of any definite evidence for the Semicostatum Zone here. However, progressively younger beds within the Blue Lias Formation are found to the south. In the Allt Mor stream section, little more than 2 km to the south, a 1.8 m-thick series of bedded crinoidal limestones not seen in Allt Leacach (Hesselbo *et al.,* 1998) has yielded *Coroniceras lyra* and *Arnioceras falcaries* indicating the basal Semicostatum Zone, Lyra Subzone.

Abundant *Caenisites turners* and *Microderoceras birchi* in the laminated mudstones above the unconformity suggest that the basal Pabay Shale Formation is no older than the Birchi Subzone of the Turneri Zone, which continues up into the

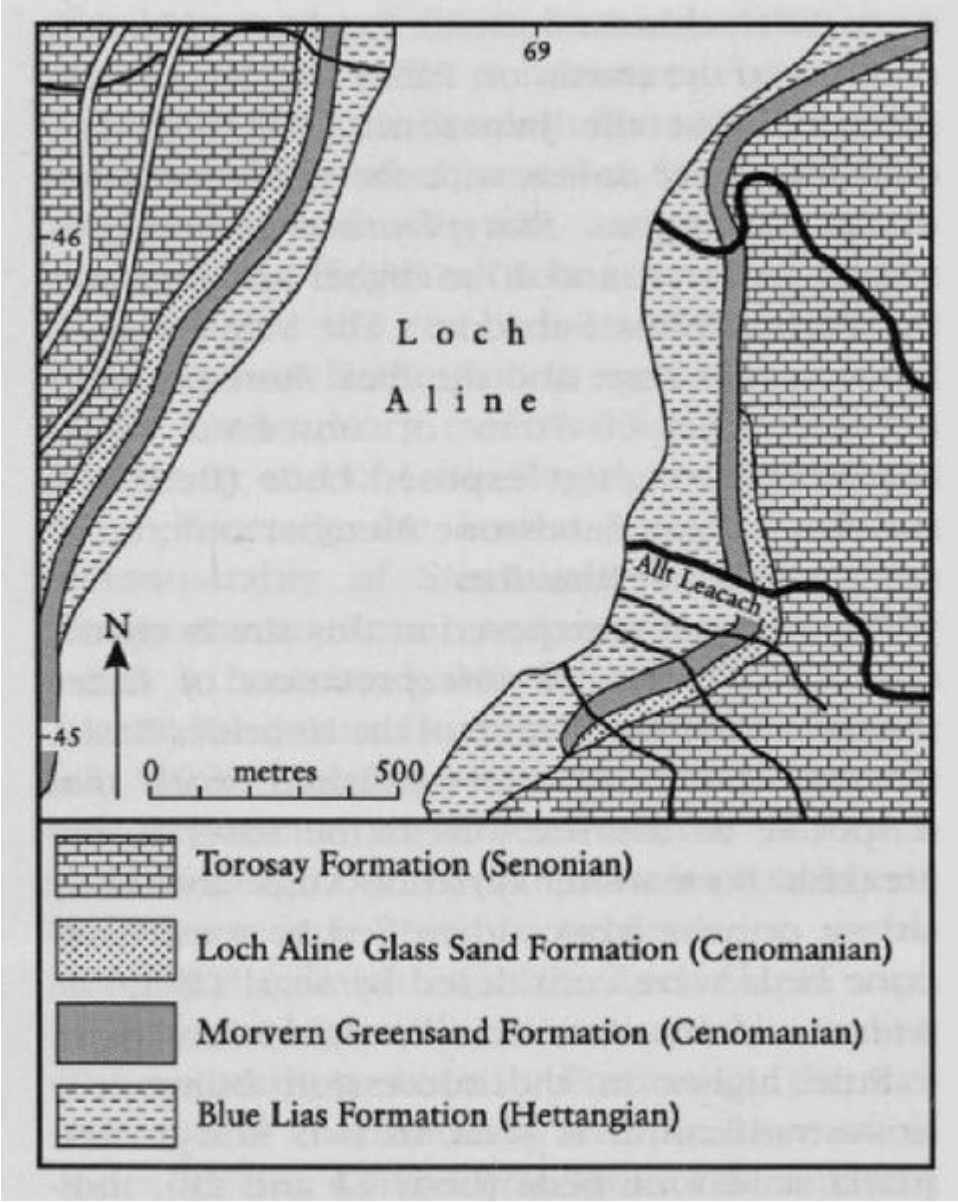
succeeding sandy mudstone. The precise boundary with the succeeding Obtusum Zone is uncertain but is provisionally placed below the occurrence of *Aegasteroceras* in Bed 74. However, *Aegasteroceras* is characteristic of levels relatively high in the Obtusum Zone (upper-Stellare and Denotatus subzones) and so its apparent presence here, below *Asteroceras obtusum,* requires confirmation. The presence of *Asteroceras obtusum, Xipheroceras* and *Promicroceras* from beds 78 upwards to the sub-Cretaceous erosion surface suggest that no level higher than the Stellare Subzone is present at this site. However, in nearby Allt Mor a single specimen of *Oxynoticeras oxynotum* 10 m below the sub-Cretaceous unconformity proves the existence of the Oxynotum Zone in the Morvern area.

The development here of the Hettangian and basal Sinemurian in typical Blue Lias Formation facies contrasts with the thick bioclastic limestones of the Breakish Formation developed elsewhere in the Hebrides Basin, such as at the Ob Lusa to Ardnish Coast GCR site. By analogy with the Panty Slade to Witches Point GCR site in south Wales, where there is a clear lateral transition from marginal bioclastic limestones to more basinal limestone–mudstone alternations typical of the Blue Lias Formation, the succession in the Morvern area suggests deposition in water slightly deeper than elsewhere in the Hebrides Basin. The preservation, to the south, of progressively younger strata beneath the Pabay Shale Formation unconformity and the transition, north of Loch Aline, from typical Blue Lias Formation to a more marginal facies suggests a tectonic component to controls on deposition in this area, with the sea floor tilted higher to the north than to the south. Currents passing across this erosion surface at the top of the Blue Lias Formation may have encouraged colonization by filter-feading benthos such as crinoids, leading to the accumulation of the crinoid-rich bioclastic limestones of the Semicostatum Zone to the south of Allt Leacach. The abrupt change in facies between the Blue Lias and Pabay Shale formations reflects a eustatic sea-level rise which affected the whole of the Hebrides Basin.

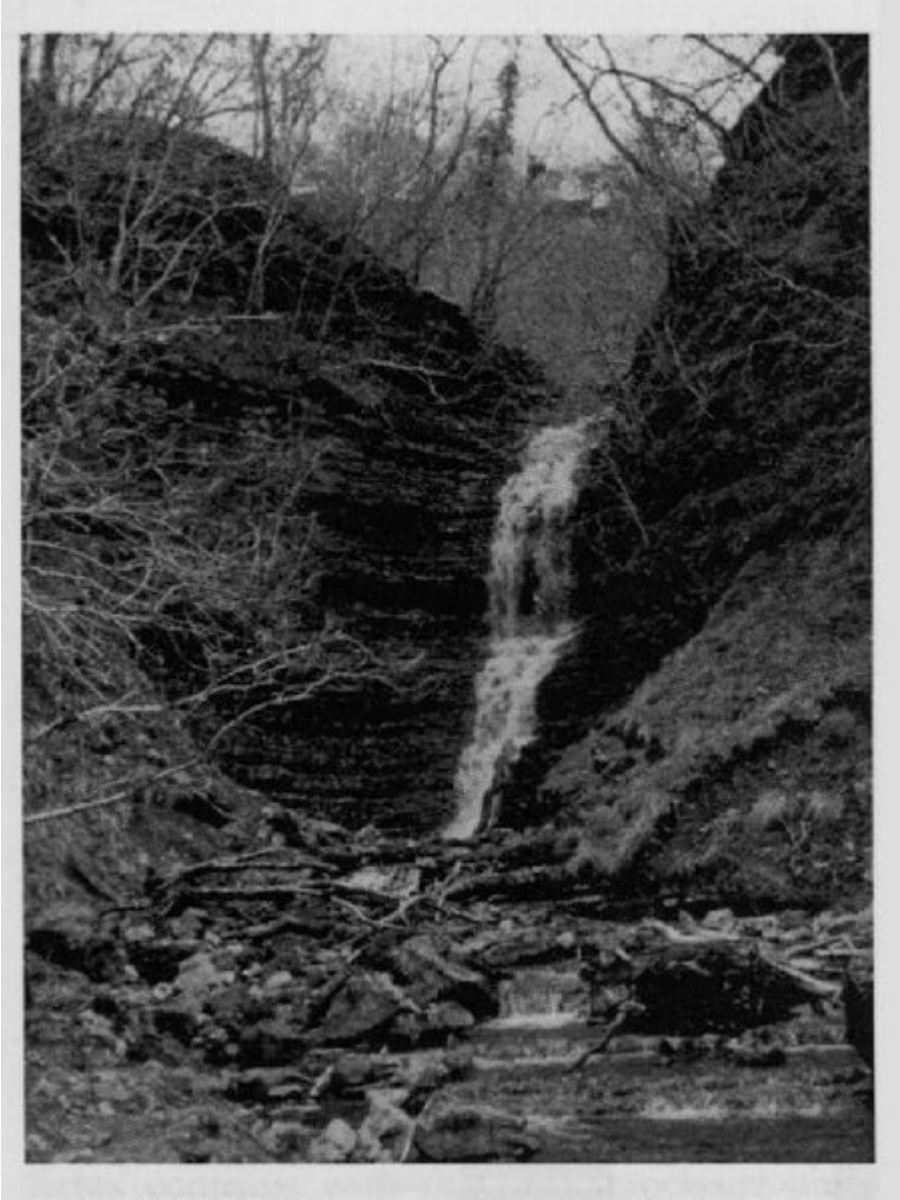
Conclusions

The exposures in the Allt Leacach Burn are the finest of several in the Morvern area. The limestone–mudstone alternations of the Hettangian and basal Sinemurian part of the succession closely resemble typical Blue Lias Formation farther south in Britain and contrast with the more marginal facies of the Breakish Formation at other GCR sites in the Hebrides Basin. The site shows clear evidence of a minor unconformity between the Blue Lias and succeeding Pabay Shale formations, and of both tectonic and eustatic controls on deposition.

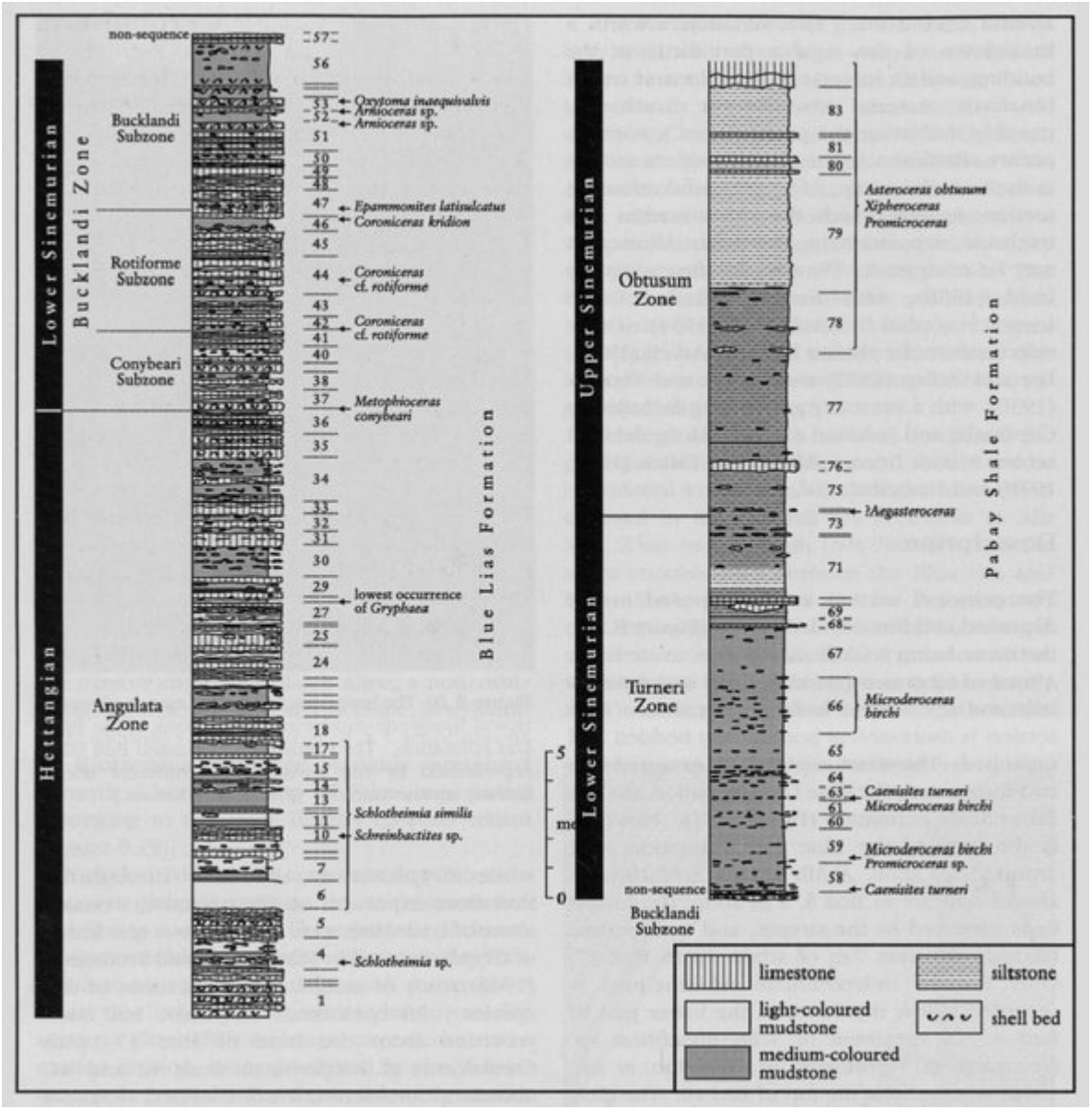
References



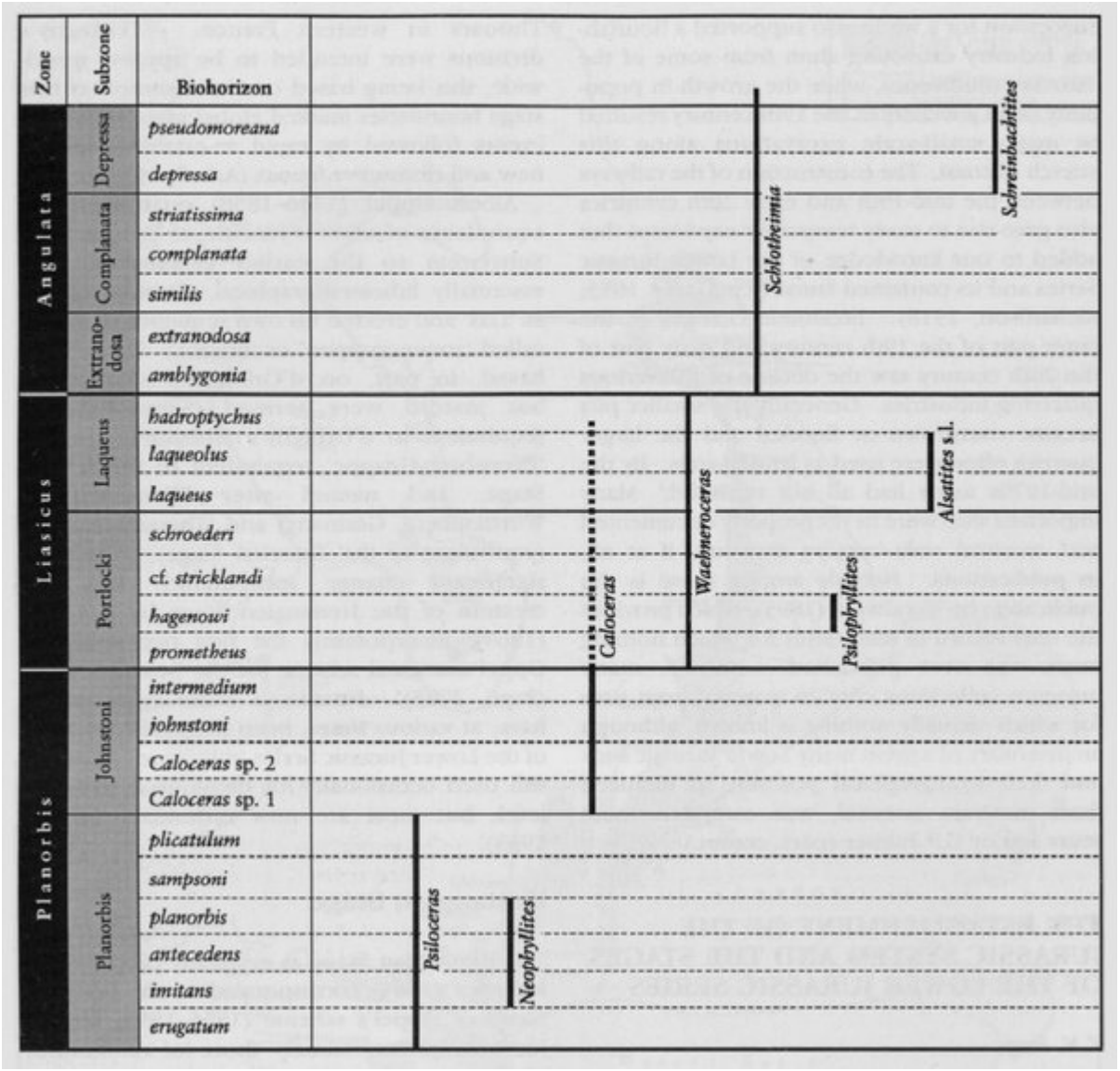
(Figure 8.19) Geological sketch map of Loch Mine and Allt Leacach.



(Figure 8.20) The lower cascade at Allt Leacach, showing typical limestone–mudstone alternations of the Blue Lias Formation. The mudstone-dominated Bed 30 is represented by the conspicuous undercut about halfway up the cascade. (Photo: M.J. Simms.)



(Figure 8.21) Section through the Blue Lias and Pabay Shale formations exposed in Allt Leacach. After Hesselbo et al. (1998).



(Figure 1.3) Sequence of zones, subzones and biohorizons for the Hettangian Stage, with the stratigraphical ranges of ammonite genera indicated (solid line — proven; dashed line — inferred ghost range). After Page (2002) and unpublished observations.